MORPHOMETRIC ANALYSIS OF KADVI RIVER FOR SUSTAINABLE WATERSHED DEVELOPMENT PLAN: A GEOGRAPHICAL STUDY WITH RS & GIS APPLICATIONS

A

SYNOPSIS OF THE PH.D THESIS

SUBMITTED TO THE

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

FOR THE DEGREE

OF

DOCTOR OF PHILOSOPHY

IN

GEOGRAPHY

UNDER THE FACULTY OF HUMANITIES

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Year

August 2023

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INTRODUCTION

Life on the earth cannot be sustained without water, whether of human beings, animals, flora, or fauna. The demand for fresh water is growing everyday, and the available source of good quality water is in the form of precipitation only, which is more or less constant. It is estimated that this available fresh water on earth is around 36,000 km^3, which returns to the oceans as runoff. It is, therefore, vital to manage this water judiciously for the survival of life on this planet. Conservation of fresh water is the prime need, and hence meaningful research efforts are r0equired in this area. Some work has already started in this area, which is popularly known as Water harvesting, but this research is still in its infancy, and much more concerted efforts are required to get some tangible results (Das, 2016).

On the earth, about ninety-seven per cent of the total available water is saline and constitutes the oceans. The remaining three per cent is the fresh water, of which seventy-five per cent is located at the poles of the earth in the form of ice and glaciers, twenty-four per cent lies buried as the groundwater, and the remaining one per cent constitutes the fresh water available on the land surface in the form of rivers, lakes, reservoirs, soil moisture and some part of it in the atmosphere. To effectively use fresh water, projects on irrigation, water supply, flood control, water powe water harvesting and navigation are taken up, which require design of different types of energy dissipating, conveyance, and storage structures. Such design work requires hydrological investigations related to storage capacity of reservoirs, flood magnitude and its frequency of occurrence, runoff peak, and seasonal variations in stream discharge.

Morphometric analysis of a river basin is important to identify and measure seasonal changes in drainage basin characteristics, recognize the groundwater potential, and address issues associated to management of soil erosion due to flash floods during the high flows. Kadvi River Basin is one of the least studied seasonal river basins in Kolhapur District which carry substantial flows during the monsoon period. In this study, morphometry of Kadvi River Basin, located in the northern part

of Kolhapur district at Shahuwadi tehsil, has been studied using remote sensing and GIS. The interrelationship between the various morphometric factors of the basin has been studied using a correlation matrix. Factor analysis has been applied to group the individual morphometric parameters into a smaller number of factors. Further, these factors have been studied in relation to the sub-basins to understand the existing relation between the factors and the sub-basins. Finally, the study identifies environmental issues of the Kadvi River Basin mostly related to the river flow regime which widens significantly during the monsoon months.

STATEMENT OF THE PROBLEM

The present study is an integrated study to measure the available surface and sub-surface water resources of the Kadvi River basin, to identify the water surplus and water scarcity zones, to bring out morphological evolution of the Kadvi River basin, and for optimum utilization of available land and water resources.

SIGNIFICANCE OF THE STUDY

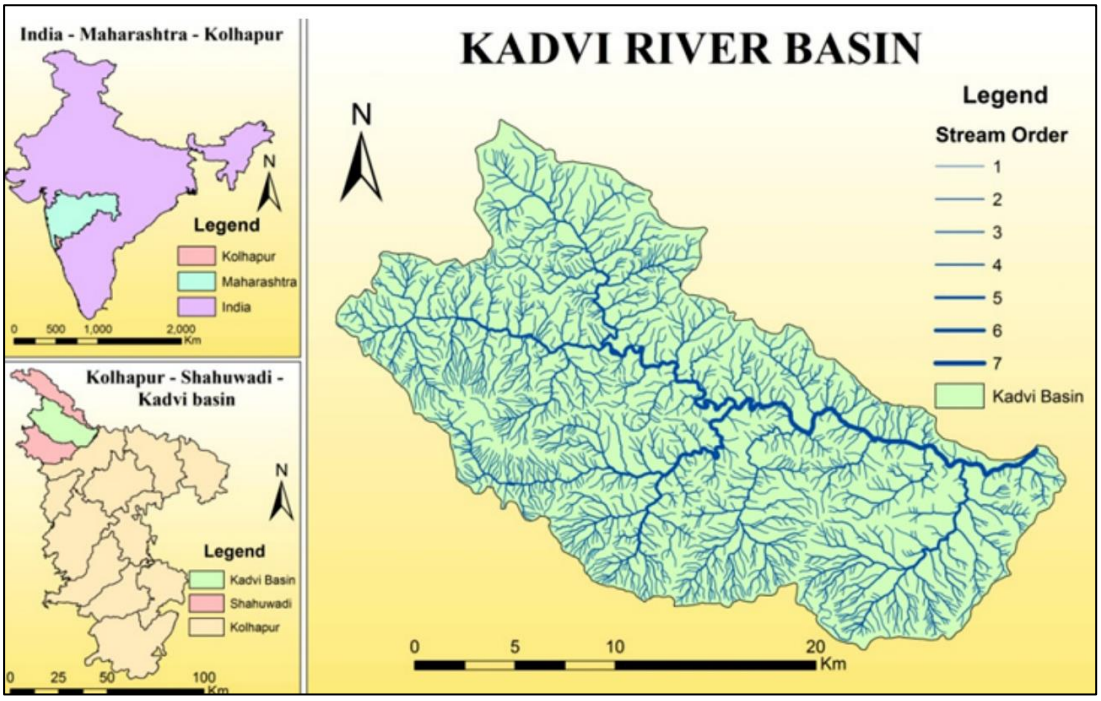
Kadvi River Basin is one of the sub basins of the Warna River drainage basin. This basin is characterized by noticeable variation in rainfall because of topographic arrangement and spatial dimension. The upper part of the watershed receives high amount of annual average rainfall (650 cm) whereas lower part receives less rainfall (150 cm). The ground water level from last few years is also becoming imbalanced due to fluctuation in rainfall and intense use of water resources for agriculture, industrialization and population. There are number of sugar factories are located in the study area. Sonavde, Warnanaga and Shirala etc.These industrial sectors also demand for large amount of water.

Recently water scarcity is a major problem in the Kadvi River Basin study area. Land degradation is another alarming problem in the study area. Improper irrigation practices, soil erosion, high amount of rainfall in hilly region, insufficient techniques to check the soil erosion, deforestation, access and excess use of fertilizers etc. activities are mainly responsible for land degradation in this area. These multidimensional geo-environmental problems have certainly provoked to serious thoughts. Therefore, an attempt will be made in the present study to perform a micro level study of this basin using Geoinformatics. This will certainly help to overcome

the problem of water scarcity as well as to prevent land degradation, improve land capability, enhance ground water percolation, conserve vegetation and enrich socio-economic and environmental well-being in the present study area (Deshmukh, 2023).

THE STUDY REGION

The Kadvi River is east flowing river originates on eastern slope of Western Ghat (Sahyadri) ranges at the Amban Ghat in Shahuwadi tehsil of Kolhapur district. Kadvi River drained the Shahuwadi and Shirala tehsils area located in the Kolhapur district including slight part of the Shirala tehsil (Sangali District) total coverage of 228.81 km2 area. After travelling 48.66 km Kadvi River meets to Warna River at Thergaon Village. The Kadvi River Basin lies between 16°48' 51.369" N to 17° 3' 5.686" N latitudes and 73°45' 58.957" E to 74° 05' 35.303" E longitudes with 428.81 km perimeter. Kadvi river is the main tributary of Warna River.



Kadvi river basin area covers 428.81 sq km with reference to SOI toposheets 47G16, 47H13 and 47L1. Ambardi, Potphogi, and Shali rivers are sub tributaries of Kadvi River. Length of Kadvi River is 48.66 km. Kadvi River basin covers nearly 41.50% area of Shahuwadi tehsil, so Kadvi River is known as the back bone of Shahuwadi tehsil. The climate of Basin is generally temperate. Heavy rainfall is found in this basin from June to October (Chougale & Jagdish Sapkale, 2017).

OBJECTIVES

(i) To study the terrain characteristics and temporal changes in land use and land cover of the Kadvi River basin.

(ii) To perform morphometric analysis to ascertain the characteristics and to infer hydrological make up of Kadvi River basin.

(iii) To assess the risk of soil erosion in understanding of the degree of land degradation in study area.

(iv) To map potential risk zones of land degradation, which will help in the prioritization of sub basins for conservation planning.

(v) To perform site suitability analysis for conservation measures and to suggest comprehensive action plan for Integrated Watershed Development (IWD) of the study area.

REVIEW OF LITERATURE

The studies on terrain analysis are carried out by Went Worth (1930), Dury (1952), Strahler (1952), Leopold and Miller (1956), Vaidyanadhan (1962), Young (1964), Chorley (1966), Doorn Camp and King (1971), Reddy and Reddy (1983) and Kaladevi (1985). The studies on morphometric analysis and fluvial geomorphology are carried out by Horton (1945), Schumm (1946), Melton (1957), Strahler (1958), Chorley and Morgan (1962) and George and Walling (1973). Sujit Chougale and J B Sankpal (2017) have Morphometric Analysis of Kadvi River basin, Maharashtra Using Geospatial Techniques. In this research paper only studied morphometry of Kadvi River. (Namdev, 2016) have studied A Geomorphic Analysis of the Yerla Basin for Watershed Management Using Remote Sensing and GIS. (Kumari, 2016) in his Ph.D Work studied, Geomorphic Evolution, Land and Water Resources and Watershed Priortization of Kunderu Basin Using Remote Sensing and GIS Techniques. (Patil & Mali, 2013) in his research paper to study Watershed Characterization and Prioritization of Tulasi Sub Watershed: A Geospatial Approach. (Sangle & Yannawar , 2014) studied Morphometric Analysis of Watershed using GIS and RS: A Review. (Patil, Pawara, & Maskare, 2013) has been worked on Remote Sensing (RS) and Geographical Information System (GIS) Based Morphometric Analysis of KR-25 Watershed to Understand Scope for Watershed Development in Sangli District of Western Maharashtra, India. In this study scope for watershed

development and management morphometric features of Krishna River (KR) 25 watershed have been selected. (Lama & Ramkrishna, 2019) studied Morphometric Analysis of Chel River Basin, West Bengal, India, using Geographic Information System. (Yogita, Patil, & Gurav, 2020) studied, Watersheds Morphometric Analysis of Kasari River Basin in Kolhapur District, Maharashtra, India.

In the present research work to studied Morphometric Analysis of Kadvi River for Sustainable Watershed Development Plan: A Geographical Study with RS & GIS Applications. This type of work done by Pragati Deshmukh in his Ph. D which is submitted in 2022. In his research work to studied Integrated Watershed Development of Pravara River Basin: A Geoinformatics Approach. In these both researches work the topics chosen for the said research are somewhat similar, the fields of study chosen by both the researchers are different. Also, the problems of watershed management in both the study areas are also different.

SCOPE OF THE STUDY

The scope of the study is useful to bring out the morphological evolution, land and water resources and for optimum utilization and sustainable land use development of the Kadvi River basin.

DATABASE AND METHODOLOGY

Primary Data

The collection of soil samples survey along with Global Positioning System (GPS) device was conducted during several field visits. The data of soil characteristics has been used to determine input parameters of various empirical equations of estimation of soil loss. This data has been helped in identifying sites vulnerable to degradation of land surface and to map it accordingly. Field visits have also been carried out in the areas of existing conservation projects like KT weir and Indo-German project as well as for collection of the information regarding soil data and validation of it.

Secondary Data

Toposheets of Survey of India at 1:50000 scale (Toposheet Nos: 47G16, 47H13 and 47L1) and ASTER (30m resolution) data has been used for morphometric

analysis of the study area. Geological Map, Geomorphic Map, Hydrological Maps has been used for understanding the hydrological characteristics. Landsat-8 satellite imageries have been used for analysis of Land Use/ Land Cover (LU/LC) of the study area. Tahsil and village boundary map collected from authorize administrative departments. Soil chemical properties data collected from the Soil Health Card (SHC), rainfall data from Hydrological Data User Group (HDUG) and census data and allied socio-economic data have also been collected accordingly.

Software's used

1. ArcGIS: Spatial interpolation, data superimposing, overlay analysis, mapping.
2. Arc SWAT: Swat modeling, streams and basins delineations.
3. Erdas: Supervised classifications, land use land cover analysis.
4. Google Earth: Monitoring and observations of study area.

Methodology

The base map has been prepared with the help of 1: 50000 SOI Toposheet. Geomorphic attributes such as slope, relief, geology, geomorphic maps have been prepared to get the idea about the overall relief of the study area. Data entry and data encoding has been performed by using various software's. The acquired data integration has been managed in GIS environment using georeferencing, digitization, image processing, query analysis, overlay analysis and data interpolation techniques. The streams and sub basins have been delineated for further studies. The morphometric analysis and USLE has been performed for sub basins of Kadvi River Basin. These Cp values of the sub basins used to prioritize the basins on the basis of their degree of soil erosion. The site suitability analysis has been performed in GIS environment for the installation of different engineering as well as biological measures. Site suitability for Continuous Contour Trench (CCT), deep CCT, Contour Band (CB), Farm Pond (FP), Gully Plug (GP), KT weirs, afforestation, fodder plantation and expansion of forest land has been attained using raster calculator, overlay operations, multi criteria analysis and query analysis techniques in GIS (Deshmukh, 2023).

CHAPTER SCHEME

The thesis has been divided into Six chapters.

Chapter I- Introduction

The first chapter deals with the general introduction, it includes statement of the problem, significance of the study, literature survey, objectives, hypotheses and methodology.

Chapter II – Physiography of Study Area

The second chapter covers the introductory statements about the region that is physiography, drainage, climatic conditions, soils and natural vegetation.

Chapter III – Morphometric Analysis

Third chapter deals with morphometric analysis of the Kadvi River basin. The areal, linear and relief aspects have been computed and discussed in this chapter.

Chapter IV – Soil Erosion Estimation

Fourth chapter advocates the USLE analysis of the Kadvi River Basin. The rainfall erosivity, the soil erodibility, the topographic factors, the crop management factor and the conservation practice factors pertaining to the study area has been illustrated and discussed in this chapter.

Chapter V- Prioritization and Site Suitability Analysis for IWDP

Fifth chapter deals with the prioritization of sub basins based on morphometric analysis and estimation of soil loss using Universal Soil Loss Equation (USLE). The site suitability analysis has also been performed for different engineering measures and biological measures.

Chapter VI- Discussion, Conclusions and Suggestions

Last chapter summarizes all the analyses, presented in this thesis, and brings out the salient conclusion and suggestions.

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